Michael Faraday. By L. Pearce Williams. Pp. xvi + 531. London: Chapman and Hall, 1965. £3 10*s*.

Matthew Arnold once wrote that "to be, like our honoured and justly honoured Faraday, a great natural philosopher with one side of his being and a Sandemanian with the other, would to Archimedes have been impossible". Professor Pearce Williams, in what is undoubtedly a major contribution to the history of physics, tries to show that Faraday's being did not have two sides. He is anxious to replace the image of Faraday the experimentalist by a picture of a genuine natural philosopher with broad and powerful theoretical ideas.

These crucial ideas were that matter is made up of point atoms from which forces emanate; a doctrine that Faraday considered, with some reason, more empirical than Dalton's. Action at a distance he believed impossible; and as he refused to accept that electricity was a *thing*, he could not accept the fluid theories of electricity beloved of the mathematicians. Armed with these notions, Faraday was able to deduce consequences, such as the laws of electrolysis and the magnetization of light, which he then tested experimentally. "Let the imagination go", he wrote, "guiding it by judgement and principle, but holding it in and directing it by *experiment*."

He was a firm believer in the inevitability of error in all human activity, and in his earlier papers he tried to present his results as far as possible in a form devoid of hypothesis. Later, his belief in the real existence of lines of force grew, and he allowed his theoretical opinions to emerge. Pearce Williams makes one of his few slips in writing that Davy's dialogue on Boscovich atoms was published in 1829; in fact it did not appear until 1840, because, being unfinished, it was omitted from the *Consolations in Travel*. Faraday's reluctance to publish his theory of matter before the 1840's is even less surprising since there was nothing in print of his mentor's on the subject. For this biography brings out Faraday's debt to Davy for the germs of many of his ideas.

Faraday's youth is fully described, and a coherent picture of the man appears. But this is primarily an intellectual biography, and its core is the chapters on theories of electricity. Anybody wishing to understand the physics and chemistry of the period will find them invaluable, for clear summaries appear not only of the views of Faraday, but also of his contemporaries. It is fascinating to see the indulgent tolerance with which so many of them seem to have regarded Faraday. It is indeed fortunate that William Thomson and Clerk Maxwell took his ideas seriously enough to cast them into mathematical form.

The book is well produced and profusely illustrated with plates and diagrams. There are many photographs in particular of Faraday in later life;

and one's only regret is that the *Punch* cartoon of Faraday giving his card to Father Thames does not appear. In short, this is the kind of work, firmly based on primary sources, which is always desirable, and particularly so in the field of the history of nineteenth-century science.

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